Network Traffic Patterns

MACADET08 123 posts since Dec 4, 2011

This is a more advanced technical question however I'd like to gain some insight on how the 3DS communicates over the network when playing online games.

I've been surprised by the apparent unconcern for Network Address Translation, UPnP, and port forwarding. The Internet connection test does not even report strict NAT even though it appears that peer-to-peer connections are used for live gaming (in Mario Kart 7 at least).

Some questions I have, but other insight would be appreciated as well:

1. What NAT traversal methods does Nintendo employ?

2. Who's considered the "host" in on-line multiplayer games like Mario Kart 7? Do these games require that all players be able to establish connections with everyone else in the party, just some of the other players, etc?


1) I am not sure if Nintendo even releases this information. There doesn't seem to be anything about it online, but I'll keep looking.

2) Everyone must be able to connect to the server, not individual players. Also, because people must always join a room in Worldwide, not create one, there is no one "host."

MACADET08 123 posts since Dec 4, 2011 2. Re: Network Traffic Patterns Feb 27, 2012 7:22 AM

Right after posting I started doing a little experimenting.
The 3DS initially contacted nnscs1.app.nintendowifi.net from port 63045 to 33334 using UDP, however during actual gameplay there’s a steady flow of UDP packets to and from what appear to be other users on "residential" internet connections (Comcast, AT&T, Cox, etc). As far as I can tell there was no further contact with the Nintendo server (at least none frequent enough to be "meaningful" with regards to live gameplay). This looks a lot like peer to peer gaming, which is how most on-line games work, yet there is no mention of port forwarding being helpful, using UPnP, or NAT type in any of the tutorials or during the connection test.

All the 3DSes establish connections with the server. The server then shares the connection information (IP addresses and ports) with all the 3DSes. Because UDP is being used, the 3DSes can send data to the connections on the other 3DSes that were originally connected to the server. Port forwarding is not necessary because the router will automatically forward to the 3DS any data sent to the IP address and port used to establish a connection with the server.

Port forwarding is only needed if you want somebody from outside your private network to establish an unsolicited connection to your computer or other device. Normally, you would not want to do this.

NAT is used by your router to translate an address on your private network to an address/port combination on the public network. It automatically creates a path through your router for any connection solicited by your computer or device on your private network. It does not allow computers on the public network to establish connections to computers on your private network.

Here's an explanation from Microsoft that explains why the peer-to-peer networking works, and why it wouldn't work if you were using TCP.
UDP Source Port Allocation and Loose Source Matching

To better support various types of peer-to-peer applications, the NAT mapping behavior for UDP differs from that of TCP in the following two ways:

**How NAT chooses the source port for outbound dynamic mappings.**

When creating a new TCP mapping for an outbound packet, the NAT driver chooses a source port without regard for already existing mappings as long as such a choice does not result in a conflict. In contrast, when choosing a source port for a UDP mapping for an outbound packet, the NAT driver determines if a mapping exists that has the same private address and port. If such a mapping exists, the NAT driver will use the same public port for the new mapping. For example:

- If a client on the private network makes a TCP connection to two different computers on the public network from the same source port, the NAT driver will choose different source ports for those mappings.
- If a client on the private network sends UDP packets to two different computers on the public network from the same source port, the NAT driver will use the same source port for both mappings.

**How NAT determines whether an inbound packet matches an existing dynamic or static mapping.**

For TCP, an inbound packet must exactly match the 5-tuple for a mapping (that is, protocol, source address, source port, destination address, and destination port). For UDP, however, an inbound packet must match only the protocol, destination address, and destination port of a mapping — the source address and source port of the packet are effectively ignored. This “loose matching behavior” applies only if the private port is greater than 1024. Allowing this behavior for ports below 1024 would introduce a security risk because it might allow unfettered access to such sensitive TCP and UDP ports as 137 (NetBIOS Name service) and 445 (Microsoft Common Internet File System [CIFS]).
I observed the UDP hole punching you described when doing my capture and that all peers sent game data to the same destination port on my 3DS.

I'm aware that certain firewalls and NAT appliances do not ignore the source IP and source port information and require that those match else those packets are discarded. I presume that in this situation the user would have trouble playing online.

Do you happen to know why XBOX Live and Playstation Network want UPnP to be enabled and check for Strict NAT, but the 3DS does not? I've done some captures of PSN gaming and it seems to work in a similar fashion, using UDP hole punching to traverse NAT.

Yes, and some firewalls will block all the UDP traffic, but one would hope that this feature could be disabled on the firewall.

The UPnP is probably used to allow the XBOX to explicitly create NAT port mappings in the router, rather than let the router handle it automatically. Microsoft suggests that enabling UPnP allows the router to operate more efficiently. The Wii and the 3DS do not take advantage of UPnP. Depending on the configuration of the router, use of UPnP should not be required to play online games with any of these systems.
It's good that the XBOX and PS3 check for strict NAT. Strict NAT makes it impossible to establish the connections required to play the games. I don't know why the 3DS and Wii do not check for strict NAT during the connection test. They really should. Passing the connection test on the 3DS only means that things like the Web Browser, the eShop, and online updates will work; online games may not work.

http://support.microsoft.com/kb/979000